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STUDIES IN ABSOLUTE PITCH.

By LUCINDA PEARL BOGGS, PH. D.

Absolute pitch is one of those curious psychological phenomena which is at present rather a puzzle. Its rarity makes it difficult of investigation and usually the people who possess it are not trained in psychological introspection. However, it has been my good fortune to know a number of people who possessed this remarkable gift and to have been able in some cases to carry out a few tests which seem to me worth recording. The fact that they were only casual acquaintances and not students of psychology, and that they were far away from a properly equipped laboratory, precluded the elaborate and extensive tests which it might be desirable to make.

By absolute pitch we mean the power to recognize a single musical note when heard, without comparison with any other tone, either objective or subjective. Von Kries¹ and Stumpf² both say that this independence of other tones is the essential characteristic of absolute memory for tones, as they have found in the process of their experimentation. The latter admits that at one time he believed the recognition of tones was dependent on the judgment of intervals, since the observer could not forget the previous tone or the indispensable *a* of the musician, but found by a series of tests that only exceptionally did the recognition of the interval affect the judgment. Whipple³ also finds that the interval sense is not used at all and that his subject is very hazy in her designation of intervals. The fact upon which all psychologists are agreed, that the more quickly the judgment of the tone is made, the more accurate it is, also goes to show that intervals are not taken into consideration.

As to the factors which contribute toward the accuracy of absolute memory for tones, the timbre of the instrument and concentration of attention have been shown to be the most important. Von Kries⁴ even considers that the slight not immediately discernible differences in the timbre of tones differently

¹ Von Kries: *Über das Absolute Gehör*, *Zeitschrift für d. Psychol. u. Physiol d. Sinnesorg.*, Vol. III, p. 265.

² Stumpf: *Tonpsychologie*, Vol. I, p. 306 ff.

³ Whipple: *Studies in Pitch Discrimination*, *Amer. Jour. of Psychol.*, Vol. XIV, p. 292.

⁴ Von Kries: *op. cit.*, p. 271.

struck on the same instrument might influence the judgment. The tuning of the instrument is also likely to influence the judgment if difference in the tuning is very great, though it has not been found that people with absolute memory have a finer pitch discrimination than other musical people.

The question whether absolute pitch can be acquired by practice or whether it is a "free gift" of heredity is one upon which it is hoped this paper may throw some light. Von Kries¹ says that he has never found any one who had genuine absolute pitch through practice, while M. Meyer² has shown that a fair degree of absolute memory may be acquired. Stumpf³ attributes at least something to practice, as he has noticed that different people judge correctly oftenest in those tone regions with which they are most familiar. Hence he finds that with most persons judgments are oftenest correct in the middle region of tones, which are, of course, the ones oftenest heard.

As to the nature of this "gift" of absolute tone memory, as Stumpf⁴ says, it must manifestly be placed under memory in general. He thinks, with Bain and Ribot, that the fineness of the sensations may have something to do with the richness of the memory. "One might say: when a sense organ presents finely gradated sensations, each one has then more help in reproduction. But on the other hand, one might equally as well conclude that the great number mutually confuse one another and disturb the reproduction. Better say, perhaps, that through the richer material a stronger necessity, and through the fineness of the possible distinction, a greater stimulus arises for employment and practice with this sense. Retentiveness itself is not greater, but the number of cases of practice increases through the variety of distinguishable sensations." In the next paragraph he says that "the completeness of the memory is more closely connected with the liveliness of the feelings than the fineness of the senses, in so far as the feelings give rise to a constant direction of the attention to a certain field of perceptions." The conclusion drawn from my own experiments agree as to the effect of a very sensitive musical hearing and the liveliness of the feelings connected with tones, as I shall show later.

The first subject in the following experiments was Miss G. G. Gulick who is extremely musical and comes of a very musical family on her mother's side. Her mother was a pianist with considerable power of improvisation and possessed a re-

¹ Von Kries: *op. cit.*, p. 262.

² Meyer: *Psychol. Rev.*, VI, p. 514.

³ Stumpf: *op. cit.*, p. 311 ff.

⁴ Stumpf: *op. cit.*, p. 287 ff.

markably sweet contralto voice. Her maternal grandmother and great aunt were extremely musical. Her older brother was a piano virtuoso and a composer, and her sister, though not a musician, was fond of music for "the thrill it gave her." She thought her mother had absolute pitch, and was quite confident that her brother must have possessed it, but as both of them had recently died, there was no possibility of verifying the supposition. Her musical education began at about the age of four with her mother and was continued under governesses until she was thirteen. From that time on, she had lessons from professors of music good, bad, and indifferent. Three months comprised her work in the theory of music, and a four years course in solfeggio covered in a few months, her vocal training. She composed little songs for children and sometimes improvised. She had had no training in memorizing tones, but always, even as a child, had been able to recognize the notes of any instrument such as a bugle, saying that it played *mi* or *la*. To test this, I once asked her the note of the dinner gong. She instantly pitched the tone with her voice, saying, "it is sol." Tunes heard on the street were easily memorized by her as a child, and reproduced on the piano. Though very faulty in technique, the result of her unsystematic training, she had the power of interpretation of music, and could give each tone a certain value in itself.

She had never heard of absolute tone memory, and when questioned as to whether she could name any note heard on the piano, was very uncertain and later was quite astonished to find that she could do it, almost without error. She had no muscular or visual sensations in judging the tone, it seemed entirely due to the sound itself. With the single tones she had no musical imagery as she had with phrases and strains. High, lively notes were bright yellow; low tones were purple or dark red; middle tones were green; when low tones were purple and high notes were added, they merged into light red and yellow. Some music seemed to her opaque, other music was like the rainbow. Likewise she professed that single notes had no emotional tone or feeling, though music often made her cry, even the gay sort. She could hear overtones so plainly, she said, that she had difficulty in picking out the fundamental tone.

This observer was entirely without practice in introspection. At first she said she calculated each tone from the preceding one, though she "pitched in on the first, right or wrong." A little later during the same test she said that her judgment was "instinctive," without any idea of the relations of the tones, and that all was due to the sound itself. Several times she asked for a note to be repeated in order to fix it firmly in her

mind and would sometimes name the note correctly on the second or even third trial. Her replies were usually given very quickly and with confidence. She was of a very decidedly objective type of observer, concentrated her mind well but was easily thrown out by any noise or confusion.

The table is easily understood, the numbers under *S* giving the series of tests; those under *O* giving the number of octaves from which the notes were selected; those under *T* the number of tones used in each series; under *R* is given the number of tones recognized correctly; under *W* the number of errors and under *P* the per cent. of right cases. The letters *G*, *C*, *D*, and *E* refer to the observers. The tones were selected at random within a given number of octaves, and there seemed to be little or no difference in the tone region, so that I have not made a particular rubric for that. The piano generally used was not especially good, though the best available at the time. The experiments were carried on in a quiet room without interruptions.

G					
S	O	T	R	W	P
1	3	40	36	4	90
2	2	40	33	7	82½
3	5	50	50	0	100
4	4	50	42	8	84
5	3	25	23	2	92
6	3	10	7	3	70
7	3	25	22	3	88
8	1	10	7	3	70
9	4	25	4	21	16
<hr/>					
D					
10	4	50	34	16	68
<hr/>					
C					
11	2	10	10	0	100
12	4	50	29	21	58
<hr/>					
E					
13	5	50	46	4	92

Series I. Four errors, all minor seconds, were made, each one being a sharp, or black key. This peculiarity was most striking and in her subsequent tests it was also found that nearly all her errors were on black keys. When told of this she was much surprised and was at a loss to account for it. Finally she explained it as a result of her having always, until

recently, called notes by syllables of the tonic *Sol-fa* system and had not called the black keys by any name different from the white keys, as *A* sharp, *E* flat, etc. Twice she was dissatisfied with her judgment, and on having the tone again given made a correct judgment. In these cases the error amounted to a major third and a minor fifth. Two chords given were also judged incorrectly the first time, but repeated at her request were judged correctly.

Series II. Only seven black keys were given and five of the seven errors were made on those tones, while the other two errors followed these and were perhaps influenced by the preceding errors as a suspicion of a mistake was likely to disturb the observer.

Series III. No black keys were given in these tests which were made on a strange, but very good new piano. This series brings out clearly the fact which the other series indicated, namely, that the tonal region made no difference with this observer. Where black keys were unevenly distributed in octaves, it was not possible to reach this conclusion satisfactorily.

Series IV. All but three errors are half tone errors on black keys. There were sixteen black keys struck and only five are judged incorrectly, which is a considerable improvement over Series II, where five out of seven are incorrectly judged. That this is due more to carefulness in naming tones than to practice in discrimination, is my opinion. The other errors are a major second, a minor second, and a major fourth. The last error was due to distraction, the subject reported.

Series V, without any black keys on the piano generally used. The errors were both half tones and both cases she reported a wandering of attention.

Series VI was a test on a clarionet. In reality twenty-five tests were undertaken, but at the close of the first ten, there was such a disturbance in the next room that only fourteen of the remaining fifteen were correctly judged, although in no case was the error more than a whole tone.

Series VII was a test on a violin. Both errors consisted in calling *f. g.* No sharps were introduced. The violin was a strange one, but the observer was familiar with violin music.

Series VIII was a test with the voice. The three errors were made on sharps, two being minor seconds and one a major second.

Series IX is a test which can hardly be tabulated with the others. Instead of single tones, chords of from two to four notes were given. All of the two tone chords were correctly recognized, but only one three note chord. The upper note of each chord was recognized twenty times out of twenty-five, but

was omitted in four tone chords. The lower tone was right fourteen times in three tone chords and omitted twice in chords of four tones. The middle notes were recognized only seven times and were omitted three times. Estimating the upper notes, her per cent. of error was 20%, larger than in any other piano test, while the per cent. for all notes in the chord is 55%. Here, as elsewhere, the black notes were the ones most often miscalled. I was not able to make all the notes stand out distinctly in the chords as in single tones, which may have influenced the results.

Considering Miss G.'s number of errors on the half tones, it would have been very interesting to test her ability to detect fine tonal differences. Unfortunately the time of her experimentation was cut short by her departure, but the following crude tests were made. The gamut was played chromatically on the violin with quarter instead of half tones. She thought it was the regular chromatic scale. Again approximately one-eighth tonal differences were given on an *E* violin string, the observer being informed of the object of the test, and she was required to judge which was the higher of two tones. Her judgment was correct in about half the trials. This shows that her pitch discrimination was not fine.

The second subject was a young woman, Miss C. Dismukes. At the time I met her she was recovering from a long nervous illness, so that extended tests were impracticable. Her musical education began so early that she could not remember when or how she learned to read notes, but at six she was playing in concerts a little. None of her immediate family are musicians, but her maternal grandparents were very musical and of an artistic temperament. At ten years of age she began the serious study of music, and studied one year in Chicago at the age of nineteen, where she had a little harmony; she discovered in that work that she could write down simple melodies, tone for tone, as she heard them. This was followed by three years in Vienna with Leschetizky, who tested her very superficially as to her memory for tones, but she had never practiced memorizing tones at all.

She thought this tone memory was a help to her in memorizing music so readily, and she always played in concerts without notes. She improvised and composed simple melodies to words. Besides concert playing she gave lessons in music. She sang a great deal for her own amusement, and found that she could recognize tones from the human voice more easily than from any instrument. Of the tones of instruments, the piano, her instrument, were the most readily recognized. She also reported that she could hear overtones very plainly. Series X was made on a fairly good piano, often used by the

observer. Nearly half her errors was in the lower tones, and a larger proportion of the remaining was in the upper tones. Black keys were recognized as easily as the white keys. Although she gave all of her answers rather slowly, often humming the tone, to fix it in her mind, she said, she believed that her recognition of the tones was immediate, *i. e.*, not calculated from any other tone. A correct judgment came more quickly than a doubtful one. An octave and a major chord were easily recognized. This observer found it difficult to concentrate her attention, and if she suspected that she had made an error, she was disturbed and was likely to make other errors. Half the errors were minor seconds and two minor fourths were the largest errors.

The third subject, Solomon Cohen, was a boy of fourteen who had absolute pitch. He was a student of the violin and had studied since he was eight years old. He sang a great deal even at four. The whole family was musical, and he had heard music of every sort ever since he was born. He thought that *f* was the easiest note to recognize and the scale of *f* was the one which he liked best and in which he played the most. His musical brother's favorite scale was *C*. They had never had any training along the line of memorizing tones, but had been taught to detect inaccuracies in the pitch of any instrument, which they did easily. *S* had a very keen ear for overtones, I discovered in testing him, and he could name those he heard most readily. His introspection in regard to naming tones was that he "just knew them and had no other note in mind."

Series XI. In the short series on his own piano, *S*. made no errors, although black keys and one chord were introduced. The octaves were the large and small octaves. His judgments, although given rather slowly, were not marked by hesitation.

Series XII. This series was given on a piano strange to *S* and rather out of tune. He remarked that the tones did n't sound natural. This experiment has value chiefly as showing the extreme effect of distraction. Another very musical boy of the same age was trying to name the tones. If *S* named the tone first he was almost sure to be right, while if the other gave his judgment first, *S* either agreed with him or was likely to make an error. The other boy did not make half a dozen independent judgments which were right. *S* said that black keys had a different sound from white keys, and though he made some errors on the black keys, he never misjudged a black key for a white key or *vice versa*. He could not explain the difference; he said, "You just know it."

The fourth subject was David Elliot, aged eight years, and was reported by his instructor in music who thoroughly under-

stands the subject of absolute pitch from the musician's standpoint. The boy began to study music at the age of six, and while his family are not musical, there is a strong artistic strain in his mother's family. He memorizes music readily, and is very clever at writing music. The piano is his instrument, but he recognizes tones of other instruments and the human voice, and he can tell readily when a tone is not true. So far as the teacher can ascertain, he has no visual or motor imagery when listening to tones, nor does he judge from the preceding note. When asked how he knew he was right, he answered, "I don't know that I'm right—I *think* I'm right." This case is particularly instructive because of the early age of the subject, and because his first teacher discovered this ability and can say that he has had no special training along that line. In the test given, series XIII, two errors are major seconds, one a minor third and one a minor fourth.

Some two or three years previous to my work with these observers, I made some tests with Miss Meyer, whom I by chance discovered had absolute pitch, but owing to a press of work and an abrupt departure, I did very little systematic work and kept no records, therefore I beg to refer any interested reader to Whipple's¹ article, whose attention I called to this case. Her per cent. of error, according to Whipple, varies from 64% to 92%, which is not so accurate as some of my subjects, and there is one fact which I do not find mentioned, namely, her very keen hearing for overtones, which was to me very remarkable.

In marked contrast with the method of these persons was that of a Miss J., who tried a series of twenty tests. Only one tone was judged wrongly and that the first one, the error being a minor third; nine were right on the first trial, six on the second, two on the third and one on the fourth and fifth each. Before making her judgment she would hum the note heard and then run over several notes with her voice until she was reasonably sure. If she failed to get it satisfactorily, she would ask for the note to be repeated and would then go through the same process until satisfied. Her introspection was that her judgment was influenced by the preceding tones. Though musical, Miss J. did not call herself a musician, and thought she had learned this way of recognizing tones from her class lessons in singing at school. Another observer in a memory experiment showed a particularly good memory for tones. Although a violinist of considerable skill, he attributed it largely to the practice in his class singing lessons of finding one tone from another, *e. g.*, taking *do* from the pitch pipe, finding

¹ Whipple: *op. cit.*

fa, so that on hearing a tone he tried to locate and name it, and in this way it became fixed in his memory. Another case of good relative pitch was that of a musical young woman who placed the first note a major second too high. The succeeding half-dozen notes were located correctly relative to the first. The next test, she placed the tone one-half note too high and located the other according to that quite correctly. She "only guessed at them" was her introspection, which is never the introspection in the case of absolute pitch.

In attempting a summary of the different cases reported, there are found to be some characteristics common to all, and again, certain peculiarities of each. Naturally we are inclined to consider the common characteristics as having the greatest bearing on the problem of the nature of the act of recognizing tones from memory. Our conclusions are as follows:

1. All of the observers have had a musical inheritance and an early musical environment and training, but in no case has there been specific training in memorizing tones.

2. An immediateness of recognition and a sureness of judgment is to be observed in all when the judgment is correct.

3. All observers have had a particularly good hearing for overtones, so far as reported. Their pitch discrimination has not been reported to be extraordinarily fine.

4. Concentration of attention was necessary to all, and noises or interruptions were disconcerting and influenced the accuracy of the observer. Each note had to be very distinctly heard.

The first two characteristics seem to indicate some special endowment of the individual who has absolute tone memory, and the last two point to its being some special fineness in the sense of hearing, probably that for distinguishing overtones so distinctly.

The remaining conclusions apply only to certain observers, and are the following:

6. The region of the tone affects the accuracy of some and not of others.

7. Although there was a rather strong emotional accompaniment for music, there was not for single notes except in one case.

8. In one case only did the semitones or black keys prove more difficult of recognition. Then it was perhaps to be attributed to a confusion of names rather than confusion of sound. In all other cases the semitones seemed to be as distinctly associated with a name as the whole tones.

9. In one case there was visual-motor imagery; one liked to fix a tone by humming it; the others did not report any help of this kind.

10. Under the most favorable condition two observers made no errors, while the per cent. of right cases with the others varied from 92% to 68%. The method of recognizing was, however, substantially the same.

These last peculiar characteristics are interesting and agree in part with those discovered by the authors already quoted, as do also the first four reported as common to all. Other investigators might, of course, find other than these four factors common to all their observers and find these as only peculiar to some.

Of course, aside from the purely scientific aspect of the matter, there is also a pedagogical interest. Even though these individuals have some particular ability, could other people imitate their method? For example: supposing that fineness of hearing for overtones is the *sine qua non* of absolute pitch, would a cultivation of the hearing of overtones aid in acquiring a fair degree of absolute pitch? The invariable associating of certain tones and certain names is of the greatest importance, as anything which has a name of its own has a more certain place in consciousness.

This would mean that in singing lessons the tones should always be named and should always be accurately pitched. It is the earnest hope of the writer that psychologists or other persons interested in this subject will investigate and report any cases of absolute memory for tones, as it is through studying mental peculiarities that we sometimes arrive at valuable results in the study of the laws of consciousness.

STUDIES IN ABSOLUTE PITCH. PART II.

Since sending in the MS. of the above it has been my good fortune to interview nine persons and to have had letters from four people who seem to have absolute pitch according to the definition of it given above. They have included one of the greatest, if not the greatest, violinist of to-day, and young students of music who are very deficient in their musical education. The degree of ability to recognize tones has varied correspondingly from persons who never make a mistake to those who cannot recognize black keys with any certainty at all.

Their introspections may be summarized as follows, and where the entire thirteen have not agreed it is because of lack of information unless otherwise specified:

1. All report that they have never had any training in recognizing tones, and consider it a natural or "inherited" ability.

2. All report a musical inheritance and a more or less musical environment, as well as an early musical education.

3. Eleven report hearing overtones very plainly, and I have

personally tested the less experienced musicians. Two have not reported on this by letter.

4. An immediateness of recognition without comparison with other tones or without motor-visual imagery of any sort is reported by eleven. Each note has a sound quite distinctive and irrespective of its place in the scale.

5. Seven report that they must be able to concentrate their mind, *i. e.*, must not be over fatigued or disturbed to attain the best results. This I have found to be true in all whom I have tested.

6. The two most unpracticed observers could not recognize the black keys, and were quite confused when they were sounded. However, one of these judged very accurately on the white keys.

7. Seven report that they can pitch any note with their voice. One lady cannot judge the notes of a voice unaccompanied by an instrument.

8. Five report that changing from a piano tuned a little lower or higher makes practically no difference in their judgments.

9. Nine report never making an error in judging a tone. These are all teachers and concert players. The others have varying ability.

The clue to the difference in the method of those having relative pitch and those absolute pitch seems to me to be found in the two facts of hearing overtones so plainly and of hearing each note quite distinctly from its relation to other tones. At first I was inclined to attribute the difference in sound to the keen hearing of overtones, since we recognize different instruments from the variation in their strong partials, and from the fact that a chord is more easily recognized than a single tone. While this may be a valuable aid, further study inclines me to the belief that there may be a tone system of qualities comparable to the spectrum in vision, and is probably due to difference in vibration rates. The scale of tones would correspond to variation in brightness, which is, of course, to be observed in the spectrum as well as the colors, and probably the average person hears the tone system as a tone scale in much the same way that a color blind person sees the spectrum as a graduated succession of brightnesses. I asked a New England Conservatory graduate who has absolute pitch whether she had the tones in her mind as she did colors. Her answer was that she had a tone system as she did a color system. The famous violinist thought that people who did not have absolute pitch must be tone deaf to a certain extent. Neither carry one tone memorized to which they refer all others.

I have never yet found any one who thought that hearing

overtones was a help in recognizing a tone, on the contrary they say it is in the tone itself, but it seems that if it lies in the tone itself, the proper way to teach young beginners would be to have them attend to the tone and its overtones so that they may know it for itself, instead of in its relation to other tones. Although very unskillful at recognizing tones myself, I have made greater progress since I have been hearing out overtones and trying to distinguish differences in the tones aside from their relation to other tones.

The following extract from Percy Goetschius Mus. Doc. puts the problem and its probable solution very neatly.

"Some music-lovers can distinguish these varying rates of velocity so accurately that they know which tone is sounding, without reference to the keyboard or comparison with other, previously defined tones. Not all persons, however,—in fact, not many,—possess this ability of defining the absolute pitch of tones; and it might therefore be concluded that any individuality of key that is based upon this distinction would be recognizable only by the very small minority of music-lovers who are thus able to define the pitch of a tone. But that proves nothing; the distinction does surely exist, whether few or many are immediately conscious of it and able to define it."